LNG Energy Determination for Custody Transfer
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Continuous Measurement with True Value™

Background
This note has been prepared for the purpose of illustrating the benefits of reliable, continuous measurement of LNG during loading and unloading of vessels for custody transfer.

In many countries in recent times there has been a significant shift from a single source of indigenous natural gas towards multiple sources of gas from new interconnector pipelines and shipped LNG. The terminal operations for LNG import and export require accurate monitoring of gas quality and flow at numerous points in order to satisfy energy accounting standards and trading contracts.

ASaP and Orbital joined forces and have developed an LNG Energy Determination solution using the GasPT product and the ASaP Phazer Vaporiser to provide accurate and continuous measurement of LNG properties so that operators can accurately and reliably account for every drop of LNG during transfer.

The GILGNL equation to calculate net energy transferred is:
\[
E = (V . \rho . GCV) - E_{\text{gas displaced in tank}} \pm E_{\text{gas to Engine Room}}
\]

Accurate measurement of the LNG density (\(\rho\)) and Gross Calorific Value (GCV) is therefore critical and these parameters will vary as loading/unloading operations proceed and boil-off gas is released.

Analysis
Cycle time of traditional GC analysers is several minutes. This can be an issue if gas is being exported out of specification and needs to be diverted rapidly for further process treatment. Furthermore, for accurate accounting when metering the LNG during transfer, the LNG flow data needs to be matched to instantaneous energy data as closely as possible; a GC cannot achieve this as it leaves significant data gaps between cycles.

Alternative technologies like the GasPTi exist which is capable of providing the accuracy required for custody transfer applications within 10 seconds. Like a GC, the GasPTi does NOT require a permanent supply of support gases, such as carrier gas, calibration gas, instrument air, etc. Its compact footprint as well as significant infrastructure to protect the device from the hazardous area and marine environment.

Solution
True Value™ is a unique integration of LNG sampling, LNG vaporisation, gas conditioning and gas analysis which provides rapid and accurate monitoring of gas quality, with T90 response time less than 10 seconds and to a CV error of less than ±0.5%. The compact Phazer LNG vaporiser is linked to the system to ensure a homogenous gas mixture at its outlet. The system mounts directly onto a pipeline or can be post-mounted nearby with a short gas sample line. Best response and accuracy is gained from pipeline mounted systems with a short sample line and electropolished internal surfaces.

Issues Vaporisation
Traditional methods for LNG energy determination use a vaporiser and gas chromatograph (GC). Partial vaporisation gives erratic readings on a GC which will affect the calculation of CV and uncertainty in the value of the LNG being transferred. As LNG is a liquid mixture at boiling point, maintaining liquid phase until the point of complete homogeneous vaporisation is a significant thermodynamic challenge.
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Depending on the application, GasPTi signal outputs can be either serial, Ethernet or analogue interfaces. Calorific Value (Gross and Net), Relative Density, Wobbe Index, Compressibility, Methane Number, Motor Octane Number and others are all standard physical properties which are output from GasPTi.

In addition to ATEX, IECEx and CSA approvals, American Bureau of Shipping type approval has been obtained for GasPT marine LNG tanker applications.

The Zone 1 True Value™ has been developed specifically for LNG applications to improve speed of response and accuracy.

Example LNG Applications

<table>
<thead>
<tr>
<th>Project</th>
<th>Company</th>
<th>Location</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isle of Grain</td>
<td>National Grid</td>
<td>UK</td>
<td>Importation terminal</td>
</tr>
<tr>
<td>South Hook</td>
<td>Qatar Petroleum</td>
<td>UK</td>
<td>Importation terminal</td>
</tr>
<tr>
<td>Dragon</td>
<td>BG Group</td>
<td>UK</td>
<td>Importation terminal</td>
</tr>
<tr>
<td>Teesside GasPort</td>
<td>Excelerate</td>
<td>UK</td>
<td>Floating regasification</td>
</tr>
<tr>
<td>Cryostar Marine</td>
<td>CNOOC</td>
<td>China</td>
<td>LNG tankers</td>
</tr>
<tr>
<td>Kanto</td>
<td>Tokyo Gas</td>
<td>Japan</td>
<td>Importation terminal</td>
</tr>
<tr>
<td>Kansai</td>
<td>Osaka Gas</td>
<td>Japan</td>
<td>Importation terminal</td>
</tr>
<tr>
<td>Gwangyang</td>
<td>POSCO</td>
<td>S.Korea</td>
<td>Importation terminal</td>
</tr>
</tbody>
</table>

LNG Applications
Gas quality monitoring on LNG export and importation terminals:
1. LNG metering
2. Export sales gas
3. Boil-off gas recondensers inlet and outlet
4. Fuel gas for revaporisation heaters

Gas quality monitoring on marine LNG tankers:
1. Boil-off gas prior to reliquefaction
2. Ship-to-ship transfer

Benefits of True Value™
- Proven technology.
- Full compliance with ISO 8943.
- Successful testing against EN 12838.
- Sub-cooled cold section insures 100% LNG sample transport to Vaporizer section.
- Integrated Zero Dead Volume™ accumulator.
- Unique flash vaporization and flow control design.
- No moving parts and practically maintenance free.
- Vaporizer complements the GasPTi-LNG instrumentation to provide LNG sampling, vaporization, conditioning and analysis in one small, easily installed system which will operate at low LNG line pressure.
- Measures at LNG pressures from 0.5 BarG.

Conclusions
1. Traditional GC analysers and vapourisers may have issues with speed of response and gas sample partial vaporisation.
2. True Value™ provides vaporization, gas sampling, gas conditioning and analysis to give rapid and accurate CV data which can be used for custody transfer, process control and alarms on LNG terminals.

Publications:
A New Method for LNG Energy Determination

GasPTi – A New Method for LNG Energy Determination
LNG 18, Perth 2016

Experiences in Gas Quality Monitoring in Natural Gas Markets
IGU World Gas Conference, Paris 2015


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